Seismic Safety of Palo Alto High School Buildings



INTRODUCTION

Research Question: Are buildings at Palo Alto High School adequate in terms of seismic safety?



Palo Alto High School: Main Office

Using Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook, buildings at Palo Alto High School were visually screened to see if any are potentially hazardous.

Other information was obtained from building plans at the District Office.

BACKGROUND AND SIGNIFICANCE

Palo Alto High School is located in a region close to the San Andreas fault, a site prone to high seismicity. In the event of an earthquake, the seismic resistance of buildings on campus is extremely important for the safety of students and staff.

After the 1933 Long Beach earthquake, the urgency of having safer buildings, especially public school buildings, was brought into light. The Field Act, a legislation that requires a high standard of review during seismic design and construction of California public schools buildings, was passed a month after the Long Beach earthquake by the California legislature (Department of General Services, 2002). The Field Act was one of the earliest legislations to improve California public school buildings by calling for better seismic resistance.



Palo Alto High School: Performing Arts Center

The 1906 San Francisco earthquake also created a prominent advance in building codes in America as it encouraged earthquake engineers to gain better understanding of effective earthquake safety standards (Cutcliffe, 2000).

The Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook guides the screener through the whole data collection form, and explains how to deduce the data collected (FEMA, 2016). This handbook is beneficial for schools that desire a quick and low cost way of detecting their building's seismic safety.

Yuan (Vivian) Wu, Christopher Rojahn Palo Alto High School, Applied Technology Council

RESEARCH METHODOLOGIES

Data Collection Form

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asic Score evere Vert icdenate W lan Irregula re-Code ost-Senchr ol Type E ol Type E o	e ical inegula erical inegu antity, Ptr mark or B (1-3 stories) (> 3 stories) (> 3 stories) CON, Suer VEL 1 SC T OF RE Reviewed:	ely, 16: Jarily, 16: (ORE, S (VIEW)	Do Not Know	B 91 2.1 -0.9 -0.6 -0.7 -0.3 1.9 0.5 0.0 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.5 -0.6 -0.7 -0.5 -0.6 -0.7 -0.5 -0.7 -0.4 -0.7 -0.4 -0.7 -0.5 -0.7 -0.5 -0.7 -0.5 -0.4 -0.7 -0.5 -0.4 -0.7 -0.5 -0.5 -0.5 -0.5 -0.7 -0.5 -0.	W1A 1.9 -0.9 -0.5 -0.7 -0.3 1.9 0.5 -0.2 -0.4 0.7 -0.4 Aar	W2 1.8 4.9 4.5 -0.6 -0.3 2.0 0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.5 -	81 (MRF) 1.5 -0.8 -0.4 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3	52 (14) -0.4 -0.5 -0.2 1.1 0.3 -0.2 -0.3 0.5 t HAZ/ tructura ding pole	RS, All 83 049 1.6 -0.8 -0.5 -0.6 -0.3 1.1 0.4 -0.2 NA 0.5 S That 1 oil Evalue mid (un	ND FIN 84 (PC SW) 1.4 -0.7 -0.4 -0.4 -0.2 1.5 0.3 -0.2 -0.3 -0.2 -0.3 -0.5 Trigger A ation?	IAL LI 85 (JRW INF) 1.2 4.7 4.3 4.4 4.1 NA 0.2 4.1 4.1 0.5	EVEL * (1057) 1.0 4.7 4.4 4.1 1.4 4.1 1.4 0.2 4.1 4.1 0.3 ACTI Details Over 10 Vice 10	1 SCO C2 (5%) 1.2 -0.8 -0.4 -0.4 -0.5 -0.2 1.7 0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.3 -0.5	RE, S (JRM INF) 0.9 -0.6 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3	L1 PC1 (TU) 1.1 -0.7 -0.4 -0.5 -0.2 1.5 0.3 -0.2 1.5 0.3 -0.2 NA 0.2 NA 0.2 NA 0.2 NA 0.2 NA	PC2 1.0 -0.7 -0.4 -0.4 -0.1 1.7 0.2 -0.1 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 -0.1 -0.1 -0.2 -0.1 -0.2 -0.1 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.2 -0.1 -0.2	(FD) 1.1 -0.7 -0.4 -0.4 -0.2 1.6 0.3 -0.2 -0.2 0.3 ed?	(#5) 1.1 -0.7 -0.4 -0.4 -0.2 1.5 0.3 -0.2 -0.2 0.3	0.9 -0.5 -0.3 -0.3 0.0 NA 0.1 0.0 0.0	1.1 N# N# 0.0 0.5 0.1 -0.1 N#
asic Score evere Vert Internet With Internet With Internet With Internet Score INAL LE INAL LE INAL LE INAL LE INAL LE INAL LE	e ical inegula erical inegu antity, Ptr mark or B (1-3 stories) (> 3 stories) (> 3 stories) CON, Suer VEL 1 SC T OF RE Reviewed:	ely, 12: Jarily, 12: Jarily, 12: (ORE, S (VIEW) Par Nor Par	Do Not Know	B 91 2.1 -0.9 -0.6 -0.7 -0.3 1.9 0.5 0.0 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.7 -0.4 0.5 -0.6 -0.7 -0.5 -0.6 -0.7 -0.5 -0.7 -0.4 -0.7 -0.4 -0.7 -0.5 -0.7 -0.5 -0.7 -0.5 -0.4 -0.7 -0.5 -0.4 -0.7 -0.5 -0.5 -0.5 -0.5 -0.7 -0.5 -0.	W1A 1.9 -0.9 -0.5 -0.7 -0.3 1.9 0.5 -0.2 -0.4 0.7 -0.4 Aar	W2 1.8 4.9 4.5 -0.6 -0.3 2.0 0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.4 -0.5 -	81 (MRF) 1.5 -0.8 -0.4 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3	52 (14) -0.4 -0.5 -0.2 1.1 0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.5 -0.5 -0.2 -0.3 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5	RS, All RS, All RS, All RS -0.6 -0.3 -0.5 -0.6 -0.3 1.1 0.4 -0.2 NA -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.3 1.1 0.4 -0.2 NA -0.5 -	ND FIN 84 (PC Swy 1.4 -0.7 -0.4 -0.4 -0.2 1.5 0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.5 Trigger A ation? dess Sur	AL LI 85 (JRN/ 112 40.7 40.3 40.4 40.1 0.2 40.1 40.1 0.5	EVEL * (107) 1.0 4.7 4.4 4.1 1.4 0.2 4.1 4.1 0.3 ACT Detail Detail	1 SCO C2 (SW) 1.2 -0.8 -0.4 -0.5 -0.2 1.7 0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.3 -0.2 -0.5	RE, S (JRM INF) 0.9 -0.6 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3 -0.3	L1 PC1 (TU) 1.1 -0.7 -0.4 -0.5 -0.2 1.5 0.3 -0.2 1.5 0.3 -0.2 NA 0.2 NA 0.2 NA 0.2 NA 0.2 NA	PC2 1.0 -0.7 -0.4 -0.4 -0.1 1.7 0.2 -0.1 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 0.2 -0.1 -0.1 -0.1 -0.2 -0.1 -0.2 -0.1 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.1 -0.2 -0.2 -0.1 -0.2	(FD) 1.1 -0.7 -0.4 -0.4 -0.2 1.6 0.3 -0.2 -0.2 0.3 ed?	(#5) 1.1 -0.7 -0.4 -0.4 -0.2 1.5 0.3 -0.2 -0.2 0.3	0.9 -0.5 -0.3 -0.3 0.0 NA 0.1 0.0 0.0	1.3 N/ N/ N/ 0.0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5
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Final Score Generation and Importance

After completing the collection form, **Score Modifier** were used to calculate a **Final (S) score**. The Score Modifiers give negative "points" for characteristics that make the building more hazardous, and positive points for characteristics that improve the seismic performance. The Final score is an estimate of the building's collapse probability in the event of an earthquake.

A Final Score of 2 means that there will be a 1 in 10^2 chance that the building will collapse. If a building has a **Final Score of 2 or lower**, that building will be considered **potentially hazardous**.

Building irregularities, soil type, geological hazards (landslides & surface rupture), the building type, and the year built, all contributes to the propensity of a building to collapse.

Building Name	Final Score
100: Art	1.7
200: English	2.3
300: General Education	2.3
400: Foreign Language	2.3
500: Library	2.3
600: Student Center	2.3
700: PE rooms	2.3
800: Social Science/Math	3.0
900: Industrial Shops	1.8
1000: Woodshop	1.6
1700: Science	3.7
Portables	1.6
Main Office	0.9
Haymarket Theatre	0.6
Media Arts Center	3.0
Performing Arts Center	3.0

a Division of the State Architect Review", was introduced to the data collection form as a positive score of 0.5 in consideration of the Field Act. It is a significant Score Modifier to include, giving the buildings a more accurate score of their seismic resistance.

After collecting and analyzing the data, 6 out of 16 buildings require further review (by an experienced earthquake engineer) to determine if they are seismically hazardous, since their Final Score is below 2.

ACKNOWLEDGEMENTS AND REFERENCES

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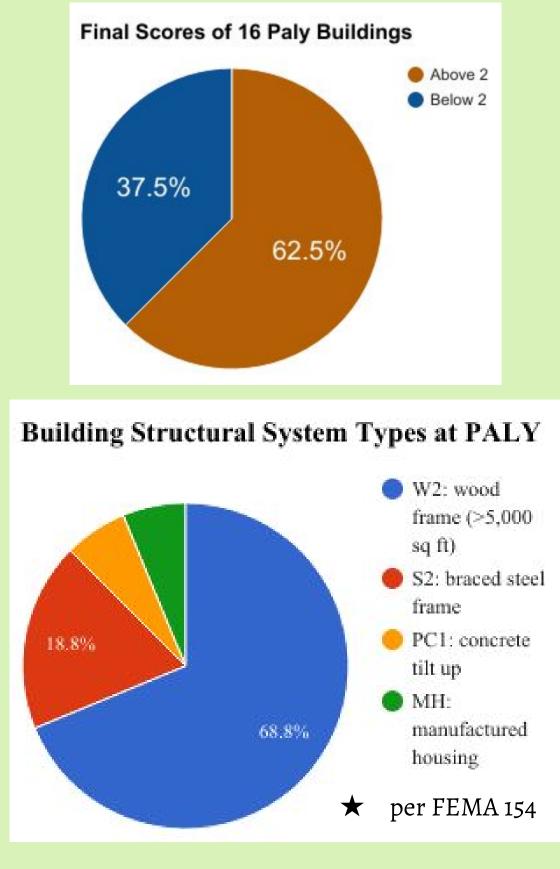
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DATA ANALYSIS AND RESULTS



There are 16 Data Collection sheets in total with detailed information on each building.

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